By Express Mail # EL793472485US · August 6, 2001

Attorney Docket # 4595-22PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Franz GLEIXNER
International Appln. No.: PCT/DE99/04126
International Filing Date: December 29, 1999
For: Displacement and/or Angle Sensor Comprising a Meandering Measuring Winding

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to examination of the above-identified application please amend the application as follows:

IN THE SPECIFICATION:

Page 1, after line 2 insert the following heading centered on the page:

--**BACKGROUND OF THE INVENTION**--

Page 1, before the paragraph beginning on line 3 insert the following paragraph:

--The invention pertains to a displacement sensor with a meander-shaped measuring winding.--

Page 1, after line 12 insert the following heading centered on the page:

--**SUMMARY OF THE INVENTION**--

Page 3, after line 17 insert the following heading centered on the page:

--**BRIEF DESCRIPTION OF THE DRAWINGS**--

Page 3, replace the paragraph beginning on line 18, with the following rewritten paragraph:

--Additional advantages and features of the invention can be derived from the following description and from the drawings in which:

Figure 1a shows a schematic diagram of an embodiment of a sensor according to the invention;

Figure lb is an end view of Figure 1a;

Figure 2 shows a schematic diagram of the voltage which can be tapped from the sensor illustrated in Figure 1a and of the magnetic induction;

Figure 3 shows a schematic diagram of the induction occurring in the sensor shown in Figure 1a;

Figure 4a shows a different embodiment of an inductive sensor making use of the invention;

Figure 4b is a section view taken on the line A-B in Figure 4a;

Figure 5a shows a schematic diagram of an exemplary embodiment of a sensor; and

Figures 5b and 5c shown the induction course in directions x and y, respectively.--

Page 4, after line 3 insert the following heading centered on the page:

--**DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS**--

Page 4, replace the paragraph beginning on line 4 with the following rewritten paragraph:

-- Figure 5a shows an arrangement consisting of a core 31 with an air gap, in which a printed-circuit board 30 is present. A coil, through which current passes, generates an alternating field in the core, which pemeates the printed-circuit board 30. The broken lines represent lines of equal induction. The diagrams (Figures 5b and 5c) next to and below these lines show the course of the induction in the direction of motion of the measuring head (x direction) and crosswise to that (the y direction). The physical circumstances make it impossible to arrive at a perfectly linear course. In contrast, it is possible to achieve a curve with good symmetry in the x direction but not in the y direction. To avoid sensitivity to lateral displacements (y direction), the induction loop is designed so that it consists of conducting tracks 32 which extend in the direction of motion of the measuring core and also perpendicular

to the direction of motion; they thus form rectangles, which project deeply into the air gap of the measuring core and thus absorb practically all of the magnetic flux in this area.--

Page 4, replace the paragraph beginning on line 19 with the following rewritten paragraph:

--Figures 1a and 1b show a design of this type. On the printed-circuit board 1 is a meander-shaped conducting track 2, one end of which is connected to an electrical connecting terminal 4 by the conducting track 3, whereas the other end is connected to connecting terminal 5. The measuring core 6 has a winding 7, through which an alternating current flows. The production of this alternating current is not described in detail here. It can be derived from, for example, DE 197-57,689.3-52 and from PCT/DE98/03,753, to which reference is made here.--

Page 8, replace the paragraph beginning on line 17, with the following rewritten paragraph:

--Figures 4a and 4b show a schematic diagram of an angle sensor for measuring angles over a range of 360° and a section view through the sensor. On a rotatably supported shaft 17, a measuring core 16 is mounted by a holder 16a in such a way that a stationary, ring-shaped printed-circuit board 15, which is concentric to the shaft, lies in the air gap of the measuring core 16. When the shaft rotates, the measuring core 16 passes over the conducting tracks 18, 19. The two conducting tracks 18, 19 are applied to opposite sides of the printed-circuit board 15. Both have the same geometry but are offset 90° from each other. The conducting track 18 is shown on the top. It is divided into two halves, and in the middle it is connected by a

conducting track 27, which forms a circle around the conducting track 18 and extends to the connecting terminal 23, to the electrical reference point of the evaluation circuit 28. On the side opposite the connecting terminals 21, 22, 23, 24, the conducting tracks 18 and 27 are connected electrically to each other by a contact point 27a. The measurement signal is tapped at the two other connecting terminals 21, 22 and also sent to the evaluation circuit. The conducting track 18 is designed in such a way that each of the two conducting tracks 27, 18 forms a loop. Some, all, or none of the magnetic flux of the measuring core premeates this loop as a function of the angular position. A voltage is induced accordingly. The voltages at the connecting terminals 21, 22 have a course which approximates a sine curve over 180°. The corresponding measuring loops on the rear (connecting terminals 21a, 23a, 24a, 22a) provide a sine curve offset by 90°, which corresponds to a cosine function. Appropriate evaluation in a circuit (not described in detail) then leads to a clear identification of the angle.--

Page 9, after line 20 insert the following new paragraph:

-- As the measuring body 6 moves along the measuring length of the housing 1, it passes over a flux path area FPA as shown in Figure 1a, this area being where the alternating magnetic field flux generated by the inductive transmission element permeates the conductor loops 2 and 9 arranged on housing. Each conductor loop 2, 9 has a feed line, e.g., feed line 3 of conductor loop 2 and a return line such as return line 2R of conductor loop 2. It is the return line of these conductor loops which at regular intervals alternate into and out of the flux path area. The locations at which the return lines are for each return line spaced one from

another at a uniform pitch. Conductor loop 2 can be arranged at one side of the housing, and the conductor loop 9 arranged on an opposite housing side. Also the conductor loop layout 9 can be offset relative to that of conductor loop 2 by, e.g., a half pitch as is the arrangement depicted in Figure 1a. It will be understood that the Figures 4a, 4b sensor includes a flux path area on housing 15 which will be defined by respective inner and outer concentric circular boundaries corresponding with the reach of the measuring core air gap.--

IN THE CLAIMS:

Please cancel claims 1-10 and replace with new claims 11-22 as follows:

11. An inductive sensor, comprising:

a fixed housing;

a body moveable on said fixed housing, said body having an inductive transmission element operative for generating an alternating magnetic field flux during movement of said body said flux passing over a flux path area of said fixed housing; and

at least one conductor loop arranged on the fixed housing so as to extend along a measurement length of said housing, said conductor loop including a feed line extending along the measurement length and a return line, said return line having a path which at regular intervals of said measurement length alternates into and out of said flux path area, a permeation of said return line at a given path location by the flux of said flux region inducing a loop output voltage indicative of a measurement length position of said body on said fixed housing.

12. An inductive sensor according to claim 11, further comprising a reference loop, said reference loop having a loop return line disposed in said flux path area so that said reference loop return line is continuously permeated by all of said flux inducing a reference loop output voltage for use as a reference for a total voltage induced with said inductive transmission element.

13. An inductive sensor according to claim 11, further comprising another conductor loop arranged on said fixed housing, said other conductor loop including a second feed line and a second return line, said second return line having a path which at regular intervals of said measurement length which are offset from the intervals of said one conductor loop alternates into and out of said flux path area, said other loop inducing a loop output voltage additive to the output voltage of said one conductor loop for indicating a measurement length position of said body on said fixed housing.

14. An inductive sensor according to claim 11, further comprising another conductor loop arranged on said fixed housing, said other conductor loop including a second feed line and a second return line, said second return line being arranged at a fixed housing side opposite a housing side at which said one conductor loop return line is arranged, said second return line at regular intervals of said measurement length which are offset from the intervals of said one conductor loop alternating into and out of said flux path area, said other

loop inducing another loop output voltage, a difference between said other loop output voltage and the voltage induced in said one conductor loop indicating a measurement length position of said body on the housing.

15. An inductive sensor according to claim 11, wherein plural independent measuring loops are provided for obtaining body position indicative measurement values.

16. An inductive sensor according to claim 11, wherein said return line path alternates into and out of said flux path area at locations spaced one from another at a uniform pitch along said measurement length, said inductive transmission element having a measuring core of high permeability material, said core having an air gap, a width of the air gap in a direction of said measurement length corresponding to said pitch.

17. An inductive sensor according to claim 16, wherein an effective length of said air gap is a whole-number multiple of said pitch.

18. An inductive sensor according to claim 16, wherein an effective length of said air gap is twice said pitch.

19. An inductive sensor according to claim 11, wherein said return line path alternates into and out of said flux path area at locations spaced one from another at a uniform

pitch along said measurement length, said inductive transmission element having a measuring core of high permeability material, said core having an air gap, an average of an induction over a width of said conductor along a line perpendicular to a measurement length direction during a movement of the measuring core rising and falling in an approximately linear form over a distance equal to said pitch.

20. An inductive sensor according to claim 11, wherein said measurement length is circular, said conductor loop being arranged on said housing in a circular course, said transmission element being mounted for rotation about said conductor loop for measuring an angular position of the body on said measurement length.

21. An inductive sensor according to claim 20, further comprising another conductor loop arranged on said fixed housing in a circular course, said one and said other conductor loops each extending over an angle of 360 degrees, said other conductor loop including a second feed line and a second return line, said second return line having a path which at regulars intervals of said measurement length alternates into and out of said flux path area, said other loop inducing another loop voltage, a ratio of said one conductor loop voltage over said other loop conductor voltage being indicative of a body angular position on said fixed housing .

22. An inductive sensor according to claim 21, wherein said output voltages of said one conductor loop and said output voltage of said other conductor loop approximate out-of-phase sine functions.

IN THE ABSTRACT:

After amended page 12, add the next following abstract of the disclosure page:

--**ABSTRACT OF THE DISCLOSURE**

An inductive sensor for determining a position of a body moveable on a fixed housing includes an inductive transmission element in the body, the transmission element being operative for generating an alternating magnetic field flux. The body is movably arranged such that the flux passes over a flux path area of the housing. At least one conductor loop is arranged on the housing along a measuring length on the housing which measuring length can extend in a linear course or a circular course. At least one conductor loop is arranged on the housing extending along the measuring length, the conductor loop including a feed line and a return line. The return line has a path which at regular intervals of said measurement length alternates into and out of said flux path area. A permeation of the return line at a given measurement path location by the flux of the flux region induces a loop output voltage indicative of a body measurement length position on the housing or of a body angular position on the body.--

REMARKS

The present preliminary amendment is being submitted prior to the issuance of a first Office Action and simultaneously with the filing of the present application. With this amendment applicant has amended the specification, cancelled claims 1-10, added new claims 11-22, and added an Abstract of the Disclosure. It also is proposed that certain drawing corrections be made as shown in red ink on the two accompanying prints and discussed in the Letter with Proposed Drawing Changes.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By: _____

Klaus P. Stoffel
Reg. No. 31,668
551 Fifth Avenue, Suite 1210
New York, N.Y. 10176
(212) 687-2770

6 August 2001

VERSION WITH MARKINGS SHOWING CHANGES

IN THE SPECIFICATION:

Revised page 1, replace the paragraph beginning on line 4 with the following rewritten paragraph:

--The invention pertains to a displacement sensor with a meander-shaped measuring winding, [according to the general type of Claim 1].

Page 3, replace the paragraph beginning on line 18, with the following rewritten paragraph:

--Additional advantages and features of the invention can be derived from the following description and from the drawings in which:

Figure 1a shows a schematic diagram of an embodiment of a sensor according to the invention

Figure lb is an end view of Figure 1a;

Figure 2 shows a schematic diagram of the voltage which can be tapped from the sensor illustrated in Figure 1a and of the magnetic induction;

Figure 3 shows a schematic diagram of the induction occurring in the sensor shown in Figure 1a;

Figure 4a shows a different embodiment of an inductive sensor making use of the invention; [and]

Figure 4b is a section view taken on the line A-B in Figure 4a;

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--Figure 1a and 1b show[s] a design of this type. On the printed-circuit board 1 is a meander-shaped conducting track 2, one end of which is connected to an electrical connecting terminal 4 by the conducting track 3, whereas the other end is connected to connecting terminal

5. The measuring core 6 has a winding 7, through which an alternating current flows. The production of this alternating current is not described in detail here. It can be derived from, for example, DE 197-57,689.3-52 and from PCT/DE98/03,753, to which reference is made here.--

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forms a loop. Some, all, or none of the magnetic flux of the measuring core premeates this loop as a function of the angular position. A voltage is induced accordingly. The voltages at the connecting terminals 21, 22 have a course which approximates a sine curve over 180°. The corresponding measuring loops on the rear (connecting terminals 21a, 23a, 24a, 22a) provide a sine curve offset by 90°, which corresponds to a cosine function. Appropriate evaluation in a circuit (not described in detail) then leads to a clear identification of the angle.--

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Assistant Commissioner for Patents
Washington, D.C. 20231
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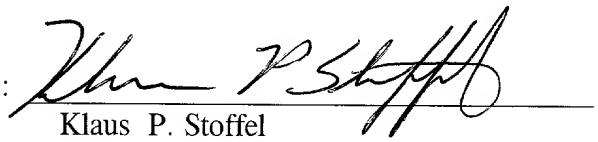
LETTER WITH PROPOSED DRAWING CHANGES

S I R:

Attached are two prints showing in red ink proposed corrections to the drawings and submitted for approval by the Examiner. Figure 1 has been corrected to designate it as separate Figures 1a and 1b, the same has been done with respect to Figure 4 which has been designated as separate Figures 4a and 4b. Also Figure 5 is now designated as separate Figures 5a, 5b and 5c. Additionally, Figure 1a has been corrected to add reference characters 2R and FPA for elements described in the specification.

It is believed that no additional fees or charges are required at this time in connection with the above-identified application; however, if any fees or charges are required at this time in connection with the application, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By: 

Klaus P. Stoffel
Reg. No. 31,668
551 Fifth Avenue, Suite 1210
New York, N.Y. 10176
(212) 687-2770

6 August 2001 -

Enclosures: Proposed drawings- 2 Sheets

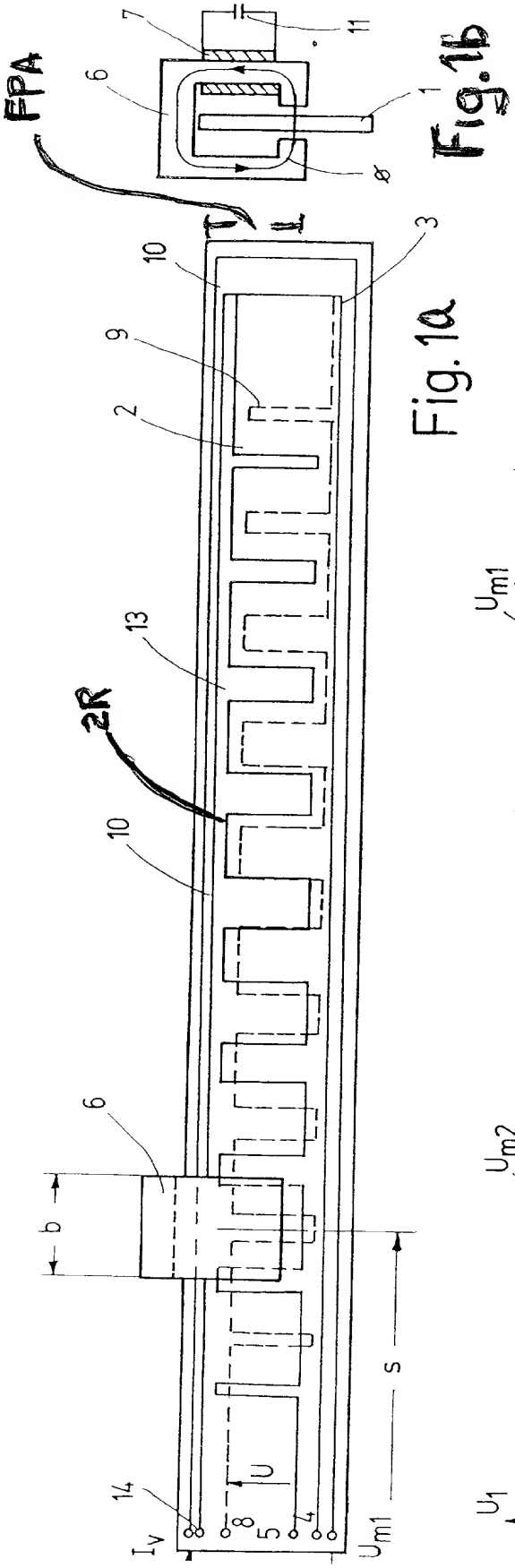


Fig. 1a

Fig. 1b

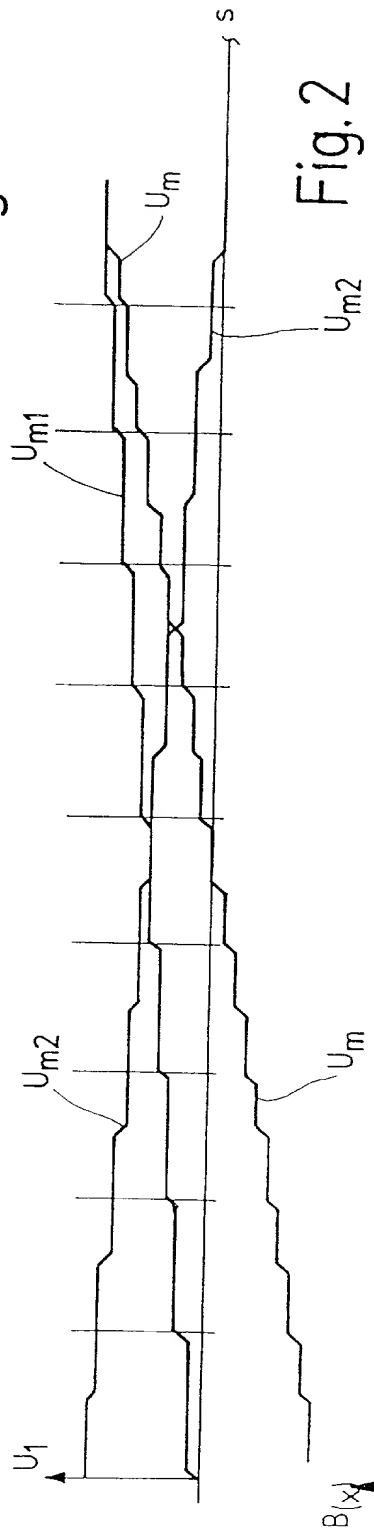


Fig. 2

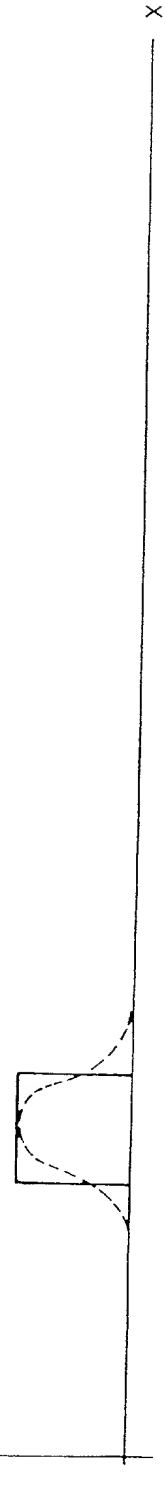


Fig. 3

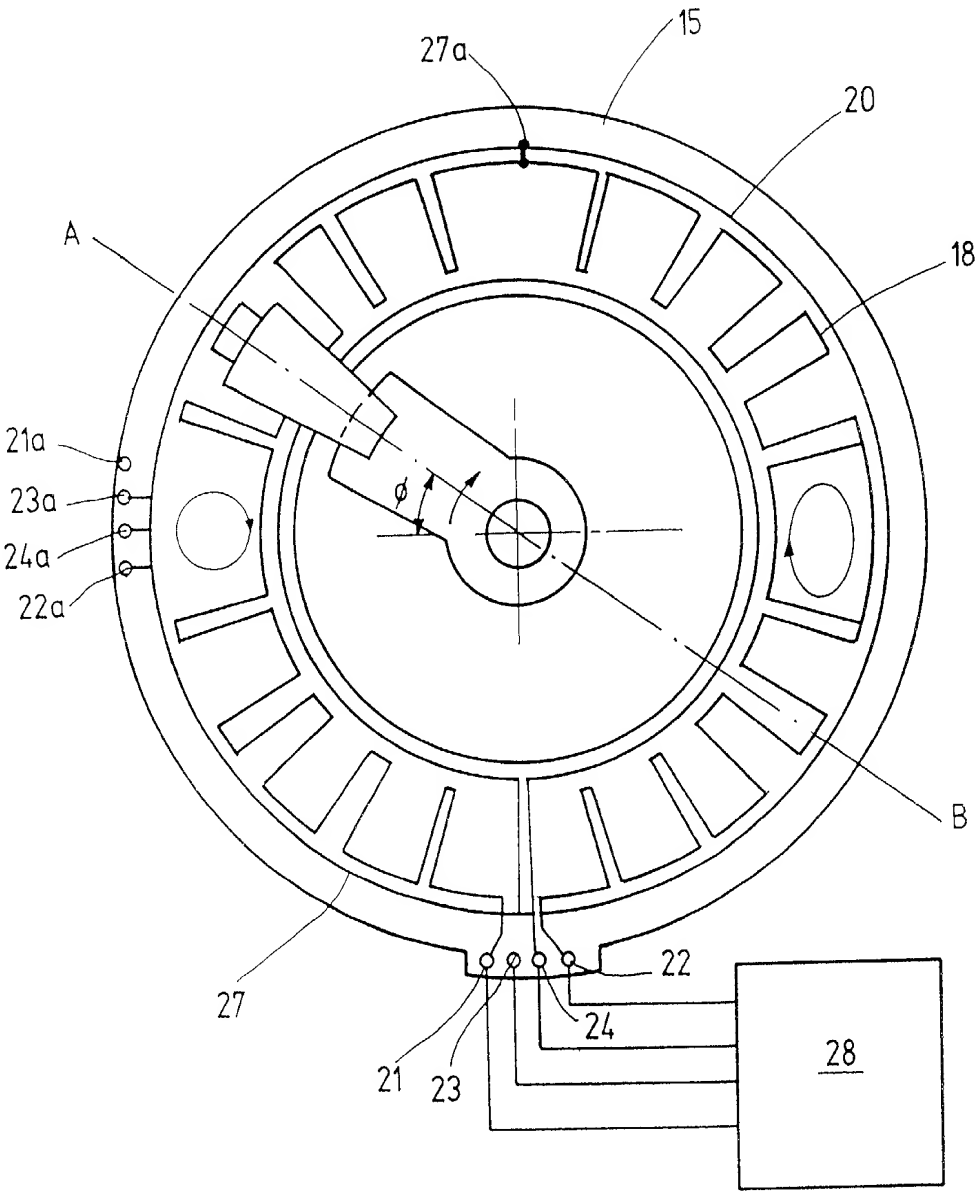
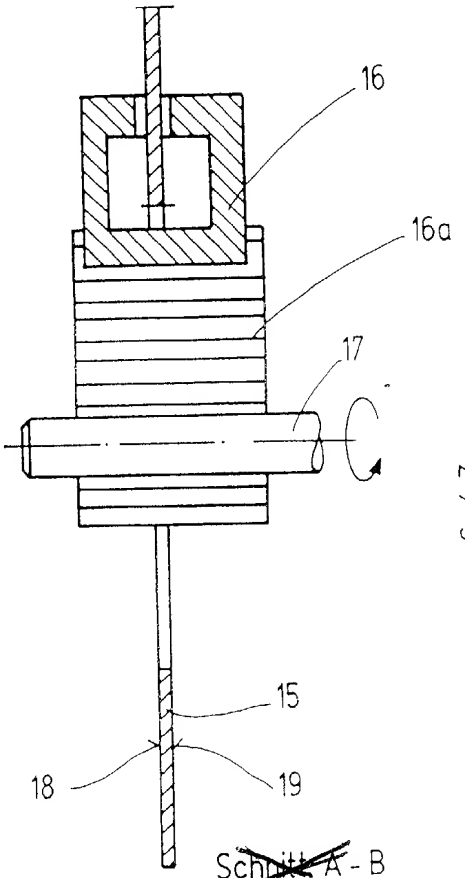


Fig. 4a



Schnitt A - B

Fig. 4b

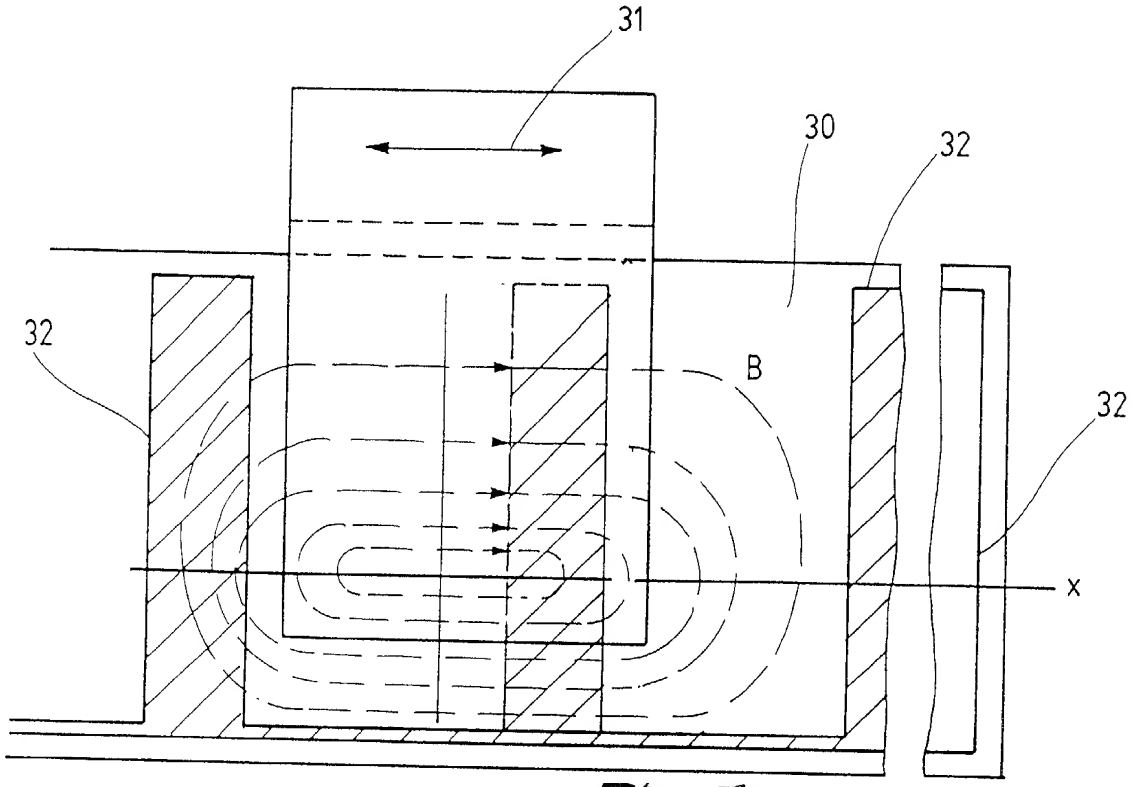


Fig.5a

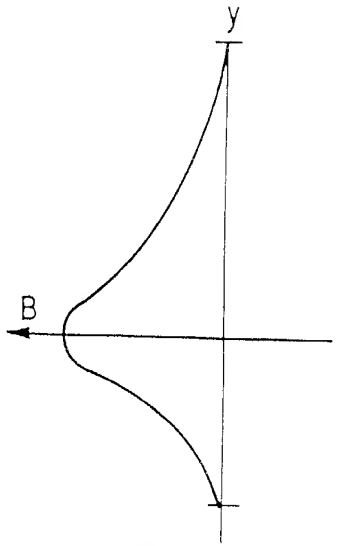


Fig.5c

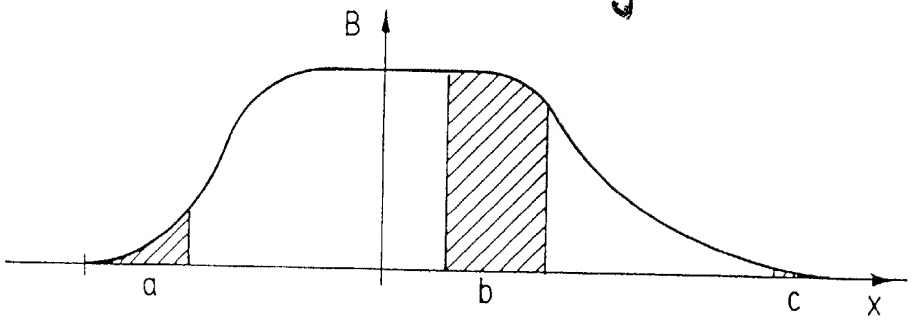


Fig.5b